PATENT ABSTRACTS OF JAPAN

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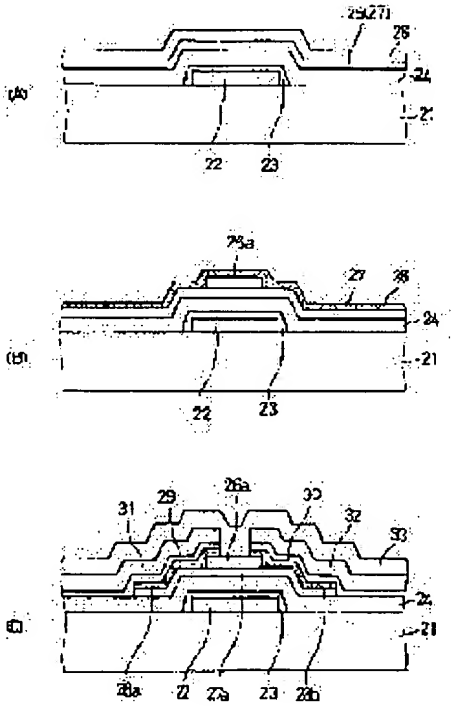
(54) METHOD OF MANUFACTURING THIN FILM TRANSISTOR

(57)Abstract:

PROBLEM TO BE SOLVED: To simplify the bottom gate type polysilicon thin film transistor.

SOLUTION: A hydrogen containing true amorphous silicon thin film 25 and a channel protective film forming film 26 comprising a silicon nitride are continuously formed on the surface of the second insulating film 24. Next, the amorphous silicon film 25 is dehydrogenated by irradiating the film 25 with excimer laser in low density in the atmosphere and then the true amorphous silicon thin film 25 is polymerized to form a true polysilicon thin film 27. At this time, this step can be performed simply by changing the energy density of the excimer laser. Besides, after the formation of a channel protective film 26a, a source region 28a and a drain region 28b are formed of a formed n type silicon film. In such a case, both impurity implanting step and activating step can be eliminated.



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CLAIMS

[Claim]
[Claim 1] The manufacture technique of the TFT which goes the scanning scanning which an excimer laser is made to overlap the last irradiation field 50% or more, and irradiates it at a hydrogenation amorphous silicon layer to all fields, and is characterized for the aforementioned hydrogenation amorphous silicon layer by dehydrogenation-ization and Pori-izing in the manufacture technique of the TFT which uses as an activity semiconductor layer contest polysilicon which has the source, a drain, and a channel field.
[Claim 2] The manufacture technique of the TFT characterized by making an excimer laser overlap last time 90% or more in invention of claim 1 publication.
[Claim 3] The manufacture technique of the TFT which makes an excimer laser the long and slender band-like shape of beam which has short width of face in invention of claim 1 publication, and is characterized by carrying out a scanning scanning crosswise [of this band-like beam].
[Claim 4] The manufacture technique of the TFT characterized by carrying out a scanning scanning in invention of claim 1 publication after carrying out multiple-times irradiation of the excimer laser.
[Claim 5] Irradiation of the excimer laser of the aforementioned multiple times is the manufacture technique of TFT that it is characterized by the beginning of an energy density being the lowest in invention of claim 4 publication.
[Claim 6] The manufacture technique of the TFT which makes all fields larger in an energy density than the 1st time after a scanning scanning, and is characterized by carrying out a scanning scanning, irradiating an excimer laser again in invention of claim 1 publication.

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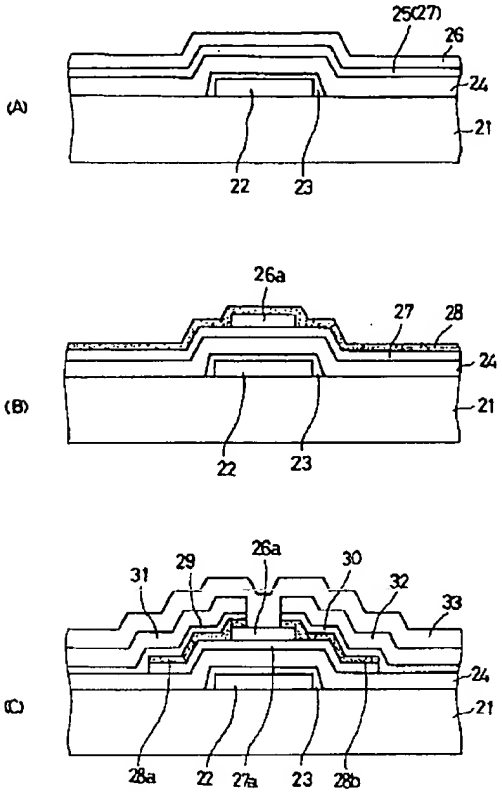
Drawing selection [Representative drawing]



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DETAILED DESCRIPTION

[Detailed description]
[0001]
[The technical field to which invention belongs] This invention relates to the manufacture technique of bottom gate type polysilicon contest TFT especially about the manufacture technique of TFT.
[0002]
[Prior art] Drawing 3 shows the manufacturing process of conventional bottom gate type polysilicon contest TFT, and drawing 4 (A) - (D) shows the cross section in each status of the TFT manufactured through the manufacturing process shown in drawing 3 , respectively. In case of a manufacture of this TFT, in gate electrode formation process A first shown in drawing 3 , as shown in drawing 4 (A), the gate electrode 2 is formed in the predetermined part of the top of a glass substrate 1. Next, in two-layer continuity **** process B shown in drawing 3 , the gate insulator layer 3 and the genuineness hydrogen inclusion amorphous silicon thin film 4 are continued and ****ed on the whole top of the glass substrate 1 containing the gate electrode 2. Next, in dehydrogenation-ized process C shown in drawing 3 , when a high energy is given by excimer laser irradiation at a next process, in order to avoid that hydrogen bumps and a defect arises, the hydrogen concentration in the amorphous silicon thin film 4 is reduced by heat-treating with the electric furnace for dehydrogenation-izing.
[0003] Next, in Pori-ized process D shown drawing 3 , by irradiating an excimer laser by the high-energy density, the genuineness amorphous silicon thin film 4 is Pori-ized, and the genuineness polysilicon contest thin film 5 is formed. Next, in impurity injection process E shown in drawing 3 , as shown in drawing 4 (B), the impurity injection mask 6 is formed on the field which serves as channel field 5a among the polysilicon contest thin films 5, and n type impurities, such as Lynn, are poured into all the fields except channel field 5a among the polysilicon contest thin films 5. Then, the impurity injection mask 6 is exfoliated. Next, in activation process F shown in drawing 3 , n type impurity injection field is activated by irradiating an excimer laser by the low-energy density. Next, in channel protective coat formation process G shown in drawing 3 , as shown in drawing 4 (C), the channel protective coat 7 is formed on the field which serves as channel field 5a among the polysilicon contest thin films 5.
[0004] Next, in device area formation process H shown in drawing 3 , as shown in drawing 4 (D), an unnecessary fraction is removed among the polysilicon contest thin films 5. In this status, the center section of the polysilicon contest thin film 5 is set to channel field 5a which consists of an intrinsic region, and the both sides are set to source field 5b and drain field 5c which consist of an n type impurity injection field. Next, in source drain electrode formation process I shown in drawing 3 , the source electrode 8 and the drain electrode 9 are formed in each top of the top both sides of the channel protective coat 7 and source field 5b, and drain field 5c etc. Next, in overcoat ****** process J shown in drawing 3 , the overcoat layer 10 is ****ed on all the top. Next, in hydrogenation process K shown in drawing 3 , the dangling bond of the polysilicon contest thin film 5 is decreased by performing a hydrogen treating by the electric furnace for hydrogenation, or the plasma furnace for hydrogenation. In this way, bottom gate type polysilicon contest TFT is manufactured.

[Object of the Invention]
[0005] By the way, by the manufacture technique of such conventional bottom gate type polysilicon contest TFT, it is got blocked, dehydrogenation-ized process C, Pori-ized process D, impurity injection process E, activation process F, and hydrogenation process K are added as compared with the manufacture technique of bottom gate type amorphous silicon TFT, and there was a problem with the former of the same type that a manufacturing process was complicated. In this case, especially, since the excimer laser equipment for the electric furnace for dehydrogenation-izing for dehydrogenation-ized process C, Pori-ized process D, and activation process F is separate equipment, it is the factor in which a manufacturing process becomes complicated and equipment investment increases. The technical probrem of this invention is reduction-izing equipment investment while it simplifies a manufacturing process.
[0006]
[The means for solving a technical problem] the scanning scanning which this invention makes a hydrogenation amorphous silicon layer overlap an excimer laser 50% or more with the last irradiation field in the manufacture technique of the TFT which uses as an activity semiconductor layer contest polysilicon which has the source, a drain, and a channel field, and is irradiated -- all fields -- going -- the aforementioned hydrogenation amorphous silicon layer -- dehydrogenation-izing -- and itis [Pori-] made toize
[0007] According to this invention, by the scanning scanning which an excimer laser is made to overlap the last irradiation field 50% or more, and irradiates a hydrogenation amorphous silicon layer, a dehydrogenation-ized process and the Pori-ized process can be performed at once, a manufacturing process can be simplified, and equipment investment can be reduction-ized in connection with this.
[0008]
[Gestalt of implementation of invention] Drawing 1 shows the manufacturing process of the bottom gate type polysilicon contest TFT in the 1 enforcement gestalt of this invention, and drawing 2 (A) - (C) shows the cross section in each status of the TFT manufactured through the manufacturing process shown in drawing 1 , respectively. In case of a manufacture of this TFT, as gate electrode formation process A first shown in drawing 1 is shown in drawing 2 (A), the gate electrode 22 which consists of an aluminum-titanium alloy is formed in the predetermined part of the top of a glass substrate 21. Next, in anodic oxidation process B shown in drawing 1 , the 1st gate insulator layer 23 which consists of an aluminum oxide is formed in the front face of the gate electrode 22 by performing an anodizing. Next, in three layer continuity **** process C shown in drawing 1 , the layer for channel protective coat formation 26 which consists of the 2nd gate insulator layer 24, the genuineness hydrogen inclusion amorphous silicon thin film 25, and silicon nitride which consist of a silicon nitride is continuously ****ed by PE-CVD on the whole top of the glass substrate 21 containing the 1st gate insulator layer 23.
[0009] Next, although dehydrogenation-izing and Pori-ized process D shown in drawing 1 are explained, since the layer for channel protective coat formation 26 is ****ed on the intrinsic amorphous silicon thin film 25 of hydrogen inclusion in this case, irradiation of the excimer laser of a low-energy density can perform dehydrogenation-ized processing of the intrinsic amorphous silicon thin film 25 of hydrogen inclusion into the atmospheric air. Then, if an excimer laser is first irradiated in about two 60-150mJ/cm with a low-energy density into the atmospheric air, the hydrogen concentration in the amorphous silicon thin film 25 will decrease, if an excimer laser is subsequently irradiated in about two 150-300mJ/cm with a high-energy density into the atmospheric air similarly, the genuineness amorphous silicon thin film 25 will Pori-ize, and the genuineness polysilicon contest thin film 27 will be formed. Thus, since a dehydrogenation-ized process and the Pori-ized process can be continuously performed only by changing the energy density of an excimer laser, a manufacturing process can be simplified.
[0010] By the way, irradiation of the excimer laser in dehydrogenation-izing and Pori-ized process D is performed by carrying out scanning irradiation, making the long and slender laser beam which has short width of face for a beam size and which was made beltlike overlap crosswise [of a beam size]. In this case, it is important to make the amount of overlap into 90 - 99% more preferably 50% or more.

Moreover, irradiation of an excimer laser makes a low-energy density to an energy density high to **** preferably twice or more, for example, makes a low-energy density and a high-energy density high 2-about 10-20mJ/cm at a time, and it may be made to perform it 3 times or more. There is the technique of enlarging an energy density after covering all fields by the technique of covering all fields in the scan scanning which shifts so that this 1 after making [in / one field / as the technique of a scanning scanning] an energy density gradually high and irradiating a multiple-times excimer laser field may be overlapped 50% or more, and irradiates an excimer laser, and repeating, and scanning scanning and irradiating an excimer laser by the low-energy density, and irradiating an excimer laser to all fields again. In addition, you may be made to perform lamp irradiation instead of excimer laser irradiation.
[0011] Next, in channel protective coat formation process E shown in drawing 1 , as shown in drawing 2 (B), channel protective coat 26a is formed in the predetermined part on the polysilicon contest thin film 27 by removing an unnecessary fraction among the layers for channel protective coat formation 26. Next, in n type silicon **** process F shown in drawing 1 , n type silicon layer 28 by which Lynn etc. was doped by the whole top of the polysilicon contest thin film 27 containing channel protective coat 26a by PE-CVD is ****ed. Next, in device area formation process G shown in drawing 1 , as shown in drawing 2 (C), while an unnecessary fraction is removed among n type silicon layers 28 and source field 28a and drain field 28b are formed, an unnecessary fraction is removed among the polysilicon contest thin films 27, and channel field 27a is formed. That is, source field 28a and drain field 28b are formed in the top both sides of channel protective coat 26a, and each top of channel field 27a in the both sides. In this case, channel field 27a consists of contest intrinsic polysilicon, and source field 28a and drain field 28b consist of n type silicon. Thus, since source field 28a and drain field 28b are formed with n type silicon layer which ****ed, an impurity injection process and an activation process become unnecessary, therefore a manufacturing process can be simplified also by this. In addition, source field 28a and drain field 28b may consist of an n type amorphous silicon or contest n type polysilicon.
[0012] the [next, / the 1st source electrode 29 which becomes each top of source field 28a and drain field 28b etc. from chromium in source drain electrode formation process H shown in drawing 1 , and] -- the [the 2nd source electrode 31 which forms 1 drain electrode 30, and becomes each of that top from an aluminum-titanium alloy continuously, and] -- 2 drain electrode 32 is formed Next, in overcoat ****** process I shown in drawing 1 , the overcoat layer 33 is ****ed on all the top. Next, in hydrogenation process J shown in drawing 1 , the dangling bond of channel field 27a, source field 28a, and drain field 28b is decreased by performing a hydrogen treating by the electric furnace for hydrogenation, or the plasma furnace for hydrogenation. In this way, bottom gate type polysilicon contest TFT is manufactured.
[0013] by the way, when the manufacturing process shown in drawing 1 is compared with the manufacturing process of conventional bottom gate type polysilicon contest TFT, [that dehydrogenation-izing, Pori-ized process D, and hydrogenation process J are only added and] If the electric furnace for hydrogenation or the plasma furnace for hydrogenation for the excimer laser equipment for dehydrogenation-izing and Pori-ized process D and hydrogenation process J is added to the manufacture process line of conventional bottom gate type polysilicon contest TFT The TFT of this invention can be manufactured by changing the manufacture process line of conventional bottom gate type polysilicon contest TFT a little, and using it as it is. In addition, this invention is applicable also to p type polysilicon contest TFT.
[0014]
[Effect of the invention] As explained above, according to this invention, by the scanning scanning which an excimer laser is made to overlap the last irradiation field 50% or more, and irradiates a hydrogenation amorphous silicon layer, a dehydrogenation-ized process and the Pori-ized process can be performed at once, a manufacturing process can be simplified, and equipment investment can be reduction-ized in connection with this.

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TECHNICAL FIELD

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PRIOR ART

[Prior art] Drawing 3 shows the manufacturing process of conventional bottom gate type polysilicon contest TFT, and drawing 4 (A) - (D) shows the cross section in each status of the TFT manufactured through the manufacturing process shown in drawing 3 , respectively. In case of a manufacture of this TFT, in gate electrode formation process A first shown in drawing 3 , as shown in drawing 4 (A), the gate electrode 2 is formed in the predetermined part of the top of a glass substrate 1. Next, in two-layer continuity **** process B shown in drawing 3 , the gate insulator layer 3 and the genuineness hydrogen inclusion amorphous silicon thin film 4 are continued and ****ed on the whole top of the glass substrate 1 containing the gate electrode 2. Next, in dehydrogenation-ized process C shown in drawing 3 , when a high energy is given by excimer laser irradiation at a next process, in order to avoid that hydrogen bumps and a defect arises, the hydrogen concentration in the amorphous silicon thin film 4 is reduced by heat-treating with the electric furnace for dehydrogenation-izing.
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EFFECT OF THE INVENTION

[Effect of the invention] As explained above, according to this invention, by the scanning scanning which an excimer laser is made to overlap the last irradiation field 50% or more, and irradiates a hydrogenation amorphous silicon layer, a dehydrogenation-ized process and the Pori-ized process can be performed at once, a manufacturing process can be simplified, and equipment investment can be reduction-ized in connection with this.

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